U.S. DEPARTMENT OF COMMERCE
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PB-261 654-T

The Effect of Molybdenum (Molybdenite) on the Nervous System

Environmental Protection Agency, Research Triangle Park, N C

1965

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA TR76-323	2.	PB 261 654-T

4. Title and Subtitle: The effect of molybdenum (molybdenite) on the nervous system

5. Report Date: 1965

6.

7. Author(s): S.L. Yeolyan

8. Performing Organization Rept. No.

9. Performing Organization Name and Address: TRANSLATED FROM RUSSIAN BY EPA

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address: Translation Service
Office of Administration - Library
Research Triangle Park, NC
27711

13. Type of Report & Period Covered

14.

15. Supplementary Notes: ZHURNAL EKSPERIMENTAL'NOY I KLINICHESKOY MEDITSINY [JOURNAL OF EXPERIMENTAL AND CLINICAL MEDICINE] VOL. V, NO. 3, 1965, pp.70-73.

16. Abstracts

17. Key Words and Document Analysis. 17a. Descriptors

EPAISD

17b. Identifiers/Open-Ended Terms

ENVIRONMENTAL HEALTH

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

17c. COSATI Field/Group 06T 57Y

18. Availability Statement: THIS TRANSLATION WAS MADE FROM A NON-COPYRIGHTED TEXT.

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 10

22. Price 3.50

362047

TR 76-323

THE EFFECT OF MOLYBDENUM (MOLYBDENITE) ON THE NERVOUS SYSTEM
(O vliyanii molibdena (molibdenit) na nervnuyu sistemu)

by

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Published in Zhurnal eksperimental'noy i klinicheskoy meditsiny
(Journal of Experimental and Clinical Medicine),
Vol. V, No. 3, 1965, pp. 70-73.

Molybdenite is the most widespread molybdenum compound in nature. In the so-called "molybdenum provinces", the soil, water, and plants contain many times more molybdenum (molybdenite) than in a standard black-earth zone. In addition to the fact that they take in surplus concentrations of this substance with their water and food, the working inhabitants of these regions are exposed, through their work, to the daily effect of large doses of it, which enter the organism through the respiratory organs and the gastro-intestinal tract.

In the Kadzharan molybdenum province, according to the data of V. V. Koval'skiy et. al. [8], the molybdenum content

Translated for NERC-Library, EPA, from the original Russian by LEO KANNER ASSOCIATES, P.O. Box 5187, Redwood City, California 94063, (415) 365-3046, January 1976.

was greater than in a standard black-earth zone (an average of 50 times in the soil and 260 times in the plants, and in the Ankavan province (Miskhana)—38 and 19 times, respectively). In the Kadzharan ore, molybdenum comprises 0.05-0.06%, and the concentrate is 48-53% pure molybdenum.

Through investigation of workers of the Kadzharan copper-molybdenum combine, our attention was attracted by frequent complaints of nervousness and objective occurrences of central nervous system disturbance. This prompted us to undertake a study of the neural status of the workers of the combine having contact with molybdenum, and the inhabitants of the "molybdenum provinces" of Armenia in general.

500 workers and the same number of residents of Kadzharan and Miskhana were investigated.

Of the 500 investigated (467 men, 43 women), 90 worked in the crushing section of the flotation factory, 14 in the drying section, and 396 in copper-molybdenum mines (underground and open), on an aerial cableway, and on a large crusher.

As. A. M. Melkonyan's investigations [9] showed, in the open quarries of the Kadzharan combine, the dust content with loading of ore exceeds the admissible concentration by an average of 56 times, with unloading—by 43 times, and at the large crusher—by 17 times. According to E. A. Babayan's data [2], the dust content in the crushing section of the factory exceeds the norm by an average of 10 to 100 times.

The majority of the workers investigated (67%) was 20-40

years old. A nervous system disorder was observed in them, basically of an asthenic nature, with subsequent definite vegetative features. They complained of general weakness, rapid fatiguability, and a dull, at times intensifying, headache with localization in the temporal sections. It is necessary to add to these symptoms irritability, poor appetite (27.7%), furred tongue (30.3%), pain in the epigastric region, and painfulness with palpation (33.3%), as well as progressive weight loss (27.9%) and superficial, non-refreshing sleep, in association with an increase in length of work service. Many mentioned that earlier, prior to arriving in Kadzharan or prior to working in contact with molybdenite, they had no such complaints (workers of the mechanical shop did not exhibit analogous complaints).

38-40% of the workers complained of pains in the joints and muscles, frequently of a polyarthralgic-polymyalgic nature, which were lingering, intermittent, and of moderate intensity. The workers mentioned that during work, and still more often at night, the leg muscles, especially the gastrocnemius, tense spasmodically, contract convulsively, and bending of the legs at the knee joint is accompanied by pain in the muscles. These occurrences continue for about 30 minutes, and go away after a massage or a warm footbath. Such attacks frequently occur after intense physical work.

As our earlier studies [4,5,6] showed, an increase in uric acid in the blood plays an important role in the pathogenesis

of the noted occurrences on the part of the joints and muscles. However, it is necessary to suppose that neuro-vegetative disturbances, which create a background for the manifestation of these occurrences, have a definite significance in these manifestations. Hypocalcinemia, caused by constant intensified diaphoresis, also plays a role in the occurrence of convulsive contractions of the gastrocnemius muscles.

[sentence not translated: typo error in original]

occurrences, especially in workers with long work service, significant vegetative disturbances are displayed, which occupy a dominant place in the clinical picture of the effect of molybdenum on the nervous system.

First, attention is attracted by the subsequent progression of weight loss, pronounced disposition to perspire, especially of the armpits and palms, dizziness, and dimness in the eyes (the latter frequently appear after a change in the position of the body, as a result of cerebral-vascular dystonia).

Of the objective symptoms, one ought to note a pronounced red dermographism (38.4%), moistness of the skin, especially of the palms, hand tremor (17.9%), and heartburn (21.7%). More than 25% of the workers noted simple zymotic diarrhea, lasting 1-3 days. It is interesting that in workers with long service and various symptoms of illness, as a result of the effect of molybdenum, a dermographism with the presence of a pronounced disposition to perspire and dampness of the hands was often weakly pronounced. The pilomotor reaction was weak in them,

whereas in workers with shorter service and fewer complaints, it was sufficiently pronounced. The same can be said about the tendinous reflexes. These data indicate the fact that, at the onset of the harmful effect of molybdenum, vegetative disturbances are manifested as the dysfunction of the vegetative nervous system, and subsequently appearances of hyporeactivity prevail (inertness of the activity of the higher vegetative centers) with low lability of the vegetative reactions, which is clinically expressed by muscular hypotonia, a bright-red dermographism in some cases, and inhibition of the skin reaction—in others (asthenic type of dermographism), by the absence of the pilomotor reflex, an increase in diaphoresis, a pronounced oculocardiac reflex, and low pulse lability with physical stress.

Thus, the investigations we conducted show that the basic manifestation of the harmful effect of molybdenum on the nervous system develop around the vegetative nervous system. These disturbances ought to be regarded as appearances of vagodystonia, because of the disturbance of the lability of the vegetative functions. Of the 500 workers investigated, pronounced vegetative dystonia was observed in 16.8% of the cases, moderately pronounced in 11.6%, and there was an astheno-vegetative syndrome in 8.4%.

It ought to be noted that vegetative-vascular disturbances are often distinctly displayed against a background of vegetative dystonia or an astheno-vegetative syndrome: a pronounced

persistent red dermographism, arterial hypotonia, and pathological vascular reactions to adequate irritants. In 52.7% of those investigated, maximum arterial pressure was less than 100 mm, while in 18.9% of the cases, it was less than 90. In 36.6% of the workers, the pressure reached 110 mm. In 79.5% of the cases, the dystolic pressure fluctuated within 50-79 mm, and in 8.7% of the cases, diastolic hypotonia was established.

Vegetative-vascular disturbances are often combined with a cardiovascular syndrome, which, after physical stress, manifests itself as shortness of breath, tachycardia, a feeling of pressure in the chest, and transient pains in the heart region. It was objectively displayed as arterial hypotonia, low pulse lability with functional stress, and myodystrophy with a reduction in the functional capability of the myocardium. As the investigations conducted in the clinical sector of the Institute of Hygiene of Labor and Professional Diseases showed, in copper-molybdenum mine workers, dystrophic changes can develop, which have a primary nature, caused by the harmful effect of molybdenum, and namely a shift in the $S-T_{II-III}$ interval, negative T_{II-III}, etc. Our experimental and pathomorphological data also indicate the harmful effect of molybdenum on the myocardium.

In 41.7% of the workers we investigated, from 40-55 years of age, pulse pressure was from 18-35 mm. It provides the possibility (when the vessels are not in a spastic condition) of judging the contracting force of the left ventricle of the heart. G. F. Lang notes that low pulse pressure indicates a lowering of the contracting force of the left ventricle.

It ought to be noted that, as compared to the workers, the indicated changes are noted much more seldom, and are significantly more weakly pronounced in the inhabitants of the "molybdenum provinces".

Summarizing the data of the investigations, we arrive at the conclusion that, as a result of the harmful effect of concentrations of molybdenite on the nervous system, the interrelation of the basic functions of the cells of the cortex are disturbed at first, which in turn leads to a neurotic condition with subsequent asthenization of the nervous system, i. e. toxic cerebrasthenia. Subsequently, according to the degree of progression of the process, the vegetative disturbances are superposed—disinhibition of the diencephalic-hypothalamic vegetative functions, which should explain the vegetative manifestations in people having constant contact with molybdenite. In the later stage, inertness of the vegetative function of the noted diencephalic-hypothalamic formations can ensue, which also causes the occurrence and intensification of vegetative-dystrophic occurrences, and namely an asthenic type of dermographism in workers with long work service, intensification of weight loss, sharp worsening of appetite, disturbance of sleep, appearance of vascular dystonia (dizziness, etc.), and other manifestations.

Thus, with prolonged work in contact with molybdenum, certain pathological disturbances can occur on the part of the central nervous system, which provides a basis for the stipu-

lation of the participation of a neuropathologist as a member of medical commissions, with periodic medical examinations of industrial workers who are exposed to the effect of molybdenum.